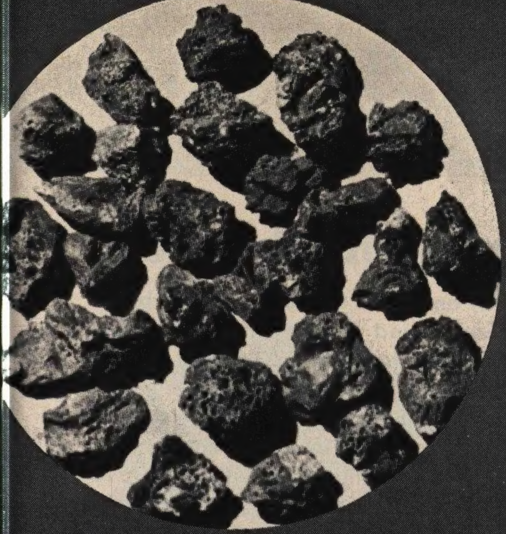
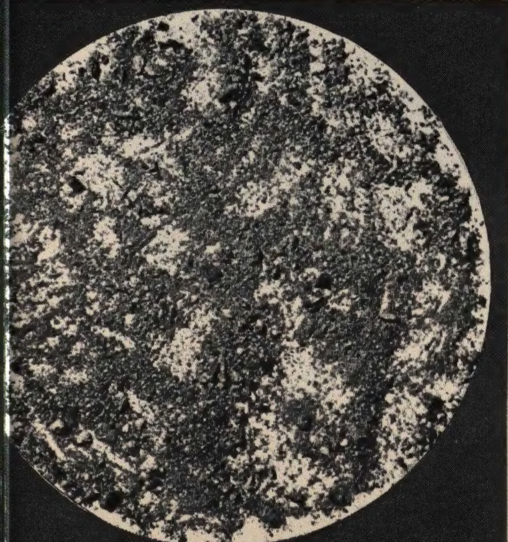


EXPANDED

clay and shale

EXPANDED CLAY & SHALE ASSOCIATION
ECSA
QUALITY LIGHTWEIGHT AGGREGATE

the lightweight
uniform
strong
concrete aggregate



the modern building material

Expanded Clay and Shale Association

DURABLE AND GOOD-LOOKING—Entrance to the Harlow H. Curtice Community College Building of the new Flint, Michigan, Junior College, gives onto an extensive window-walled lounge, with walls of exposed and painted expanded clay lightweight block that typify the attractive, economical qualities of lightweight aggregate construction. Architects: S. A. Nurmi and Associates, and Louis C. Kingscott and Associates, working in association. General Contractor: Herlihy Mid-Continent Company.

• for better building

Expanded clay and shale aggregates make better lightweight blocks and lightweight concrete because they are manufactured under close control. They have been recognized by increasing numbers of architects, engineers and contractors as the modern building material of extremely versatile character which meets all state and federal specifications.

The range of uses of lightweight aggregates made from expanded clay and shale is exceptional. In these pages, the producer-members of The Expanded Clay and Shale Association will point out some of the applications.

It is noteworthy that in various geographical areas of the United States, this product has been successfully used in schools, churches, office buildings, factories, warehouses, homes, commercial structures—everywhere where lightness of weight without sacrifice of strength is wanted.

High-strength lightweight concrete made from expanded clay and shale adds up to important savings on structural steel and related items. This is a product which boasts a wide adaptability to *all* types of concrete uses, including load-bearing walls, floors, ceilings, roofs, and back-up for face brick, stone and stucco. Whether the need is for masonry units, structural concrete, floor systems, pre-cast concrete, bridges, bridge floors or other advanced building methods, this product is the finest choice.

expanded clay and shale

• the product

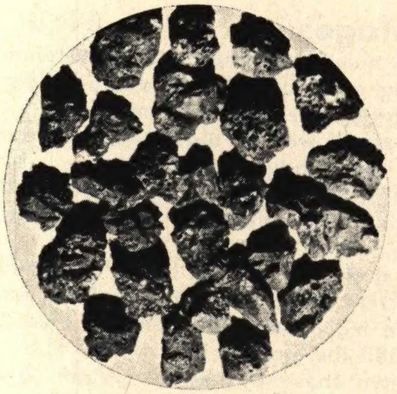
Burned clay or shale aggregates have been tested and proven for more than 30 years—a ripe age when measured in terms of modern construction techniques. As early as World War I, the product was utilized for ships made of concrete—an historic "first" that established firmly and conclusively the vital importance of clay or shale aggregate. Since then, progress has been steady and sure. The end of World War II gave new impetus to the use of the product, and today it is a valuable ally to the building industry.

Burned clay or shale aggregate has been subjected to various tests under expert and impartial engineering supervision. The Expanded Clay and Shale Association represents producer-members in major regions of the United States who are concerned with coordinating information about the product for architects, engineers, contractors, designers and similar categories of building officials.

The almost unlimited availability of clay and shale tends to reduce the cost of the aggregate to the user, because the expense of the material is relatively low and enables the manufacturer to pass the resultant economies on to the consumer. Notable, too, is the fact that a long-range source of supply is assured.

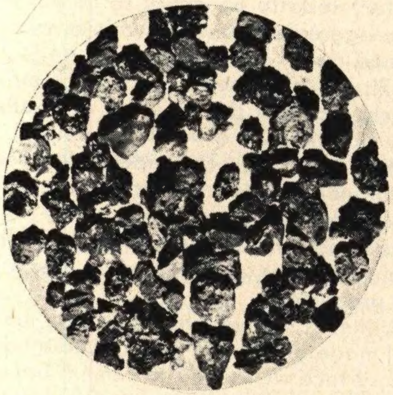
The aggregate can be crushed and screened to produce the desired gradation for either block or structural concrete. One of the virtues of the manufacturing process is that close control assures perfect uniformity of product at all times.

• commercial sizes



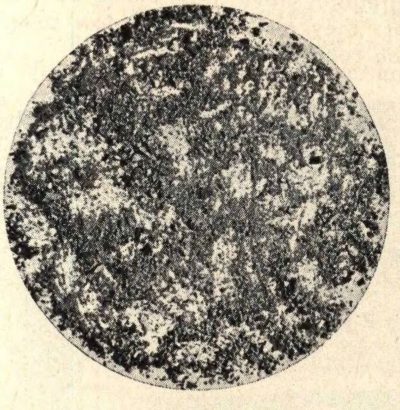
3/4″

Expanded clay or shale—graded from 3/4″—#4 ASTM.



1/2″

Expanded clay or shale—graded from 1/2″—#8 ASTM.



sand

Expanded clay or shale—graded from #4 to pan ASTM.

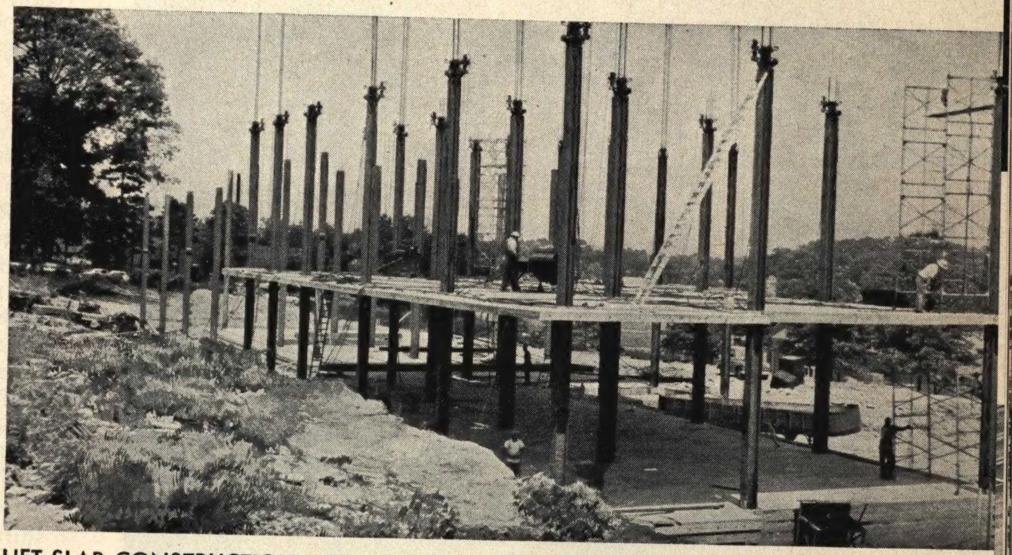
• how lightweight aggregate is made

manufacture

The aggregate is produced by expanding or bloating clay or shale, the raw material being a selected product that is mined and delivered to the furnace plant as required. This process insures a continuous supply of raw material and a careful control of the material so that high standards are consistently maintained.

mix designs

For specific mix designs, it is recommended that the producer in a particular area be contacted to submit a mix in accordance with the specifications. It will be recognized that because of a variation in requirements of concrete unit weights, strength, slump and other job conditions, it would be impractical to incorporate specific mix designs in one table.



LIFT-SLAB CONSTRUCTION—Expanded clay and shale lightweight aggregate is favored by many architects and contractors for the new "lift-slab" technique of construction. This photograph shows early building progress at Mercy Hall, a nurses' home for Saint Mary's Hospital, Knoxville, Tenn., during the first lift about half way up the first column section. Expanded shale aggregate was specified. Architects-Engineers: Maguolo and Quick, and L. P. Cotter, AIA. General Contractors: Foster & Creighton. The completed building will be six stories high.

bloating process

The process of bloating the clay or shale makes use of a sintering method in furnaces of special design. As the material travels along the slowly moving grate of the sintering machine, the burning process heats the mass to the point of incipient fusion. The clay or shale is expanded into an inert and structurally strong lightweight aggregate. At high temperature, certain constituents are driven off as gases and the particles are brought to a pasty state. Temperature recording and controlling devices at numerous points in the furnace insure the production of a uniform sinter.

crushing process

The bloated material emerges from the sintering machine as a continuous cake or slab. The material is now in a clinker form and has reached a temperature of more than 2300 degrees F. This cake is broken after cooling, and passed on to a primary crusher, then to a grading plant where it is crushed again and screened to produce the gradations specified for its various applications. The crushing and grading are controlled carefully, to insure that consistently high quality is maintained with no alteration in the basic characteristics of the aggregate.

expanded

A BIG OFFICE BUILDING—This is the famous Denver Club Building, Denver, Colorado. All floors were cast with expanded lightweight aggregate. Lightweight aggregate blocks were used for partitions and backup, too. The building was finished in 1955. Architect: Raymond H. Ervin. Engineers: Technic Engineers. General Contractor: Mead and Moun Const. Co.

advantages

There are numerous benefits to be obtained from using expanded clay and shale lightweight aggregate. Here are some:

1. Lightness of weight. Blocks and concrete made of this product are lighter . . . the weights, lbs. per cu. ft, are one-third to one-half less than concrete made with dense aggregates.
2. Great strength. Concrete blocks and structural concrete made with lightweight aggregate have high compressive strengths up to 6,000-7,000 lbs. per sq. in.
3. Stability. These aggregates retain their firm, constant characteristics under the most adverse conditions.
4. Inertness. The composition is such that use of this product will not cause corrosion or discoloring nor is there any reaction with cement.
5. Resistance to freezing and thawing. Shown by laboratory tests to be equal to or better than dense aggregate concrete with or without entrained air.
6. Nailability. When used for concrete masonry, blocks made of this material are nailable. They handle well without chipping.
7. Insulating qualities. Expanded clay or shale aggregates have low coefficients of thermal conductivity.
8. Fire resistance. Possesses extremely high fire-resistant qualities. It is in wide use for refractory products.
9. Paintability. A lightweight aggregate masonry wall made of sintered clay or shale has a textured surface well suited to cement base, casein or oil base paint, and produces a soft color tone pleasing to the eye.
10. Textural qualities. Uniform in appearance and shape, with a fine-textured surface suitable for both interior and exposed concrete.
11. Acoustical benefits. Expanded clay or shale aggregates have high sound absorption values. They also have very low sound transmission coefficients.

A SMALL OFFICE BUILDING—This attractive structure is a two story building with a number of offices on the second floor. All of the interior is block finish, painted in eye-pleasing pastel colors. Architect: John Erwin Ramsay, Salisbury, North Carolina. Contractor: Hugh D. Pinkston Company.

clay and shale

uses

A versatile range of uses is available with expanded clay or shale. The following is a partial list of the more frequent examples.

1. Masonry units.
2. Structural concrete.
3. Floor systems. Load-bearing walls. Ceilings.
4. Pre-cast concrete.
5. Low temperature refractory concrete.
6. Pre-stressed and post-tensioned concrete.
7. Roof fill.
8. Back-up for face-brick, stone and stucco.
9. Lift-Slab and Tilt-Up units.

High-strength concrete and masonry units made with this product weigh at least one-third less than dense aggregate. Thus there is a substantial reduction in dead load. This means economy in construction through use of thinner slabs, longer slabs, reduced depths of beams and girders, and reduced loads on footings. State, Federal and ASTM requirements for load-bearing are met.

The smooth workability and ease of handling in all conventional methods of mixing, transportation and placement also makes possible significant savings in labor costs. The need for special insulating materials is eliminated. One of the newest uses for lightweight aggregate concrete involved the support and position of corrugated iron pipe in water in order to form an outfall into the bay of the Raritan River, New Jersey. This example serves to illustrate the diversified adaptability of lightweight aggregate to advanced as well as conventional building methods.

Expanded clay and shale lightweight masonry units are ideally suited to interior partitions in homes, commercial and industrial buildings, as well as for load-bearing walls. Variations in color, texture, unit sizes and shapes add interest and beauty to permit unprecedented freedom of design for architects and engineers, as well as key building economies and construction techniques for contractors.

NEW YORK LANDMARK—The new Fifth Avenue office of Manufacturers Trust Company in New York City, at Fifth Avenue and Forty-third Street, employed lightweight concrete for floor fill. Architect: Skidmore, Owings & Merrill. Engineer: Weiskopf & Pickworth. General Contractor: George A. Fuller Co. Concrete Contractor: Rizzi Construction Co. Lightweight concrete met specifications of 75 lb./cu. ft. and 600 p.s.i. at 28 days.

WAREHOUSE MODERN STYLE—This 150'x300' warehouse in Memphis, Tenn., has lightweight block walls made of expanded clay and shale aggregate. The prestressed roof channels were also designed of lightweight concrete in 50-foot lengths and a width of three feet with 45-pound dead load and 35-pound super imposed load. Built by John A. Denies Sons Company.

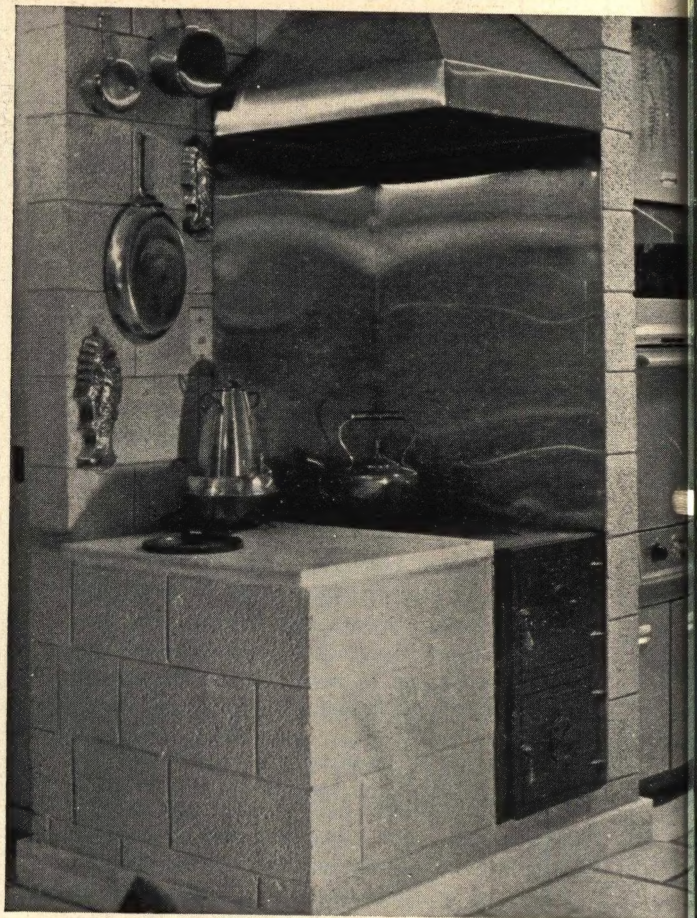
STATE OFFICE BUILDING—This is the Cordell Hull Memorial Building, state office building in Nashville, Tenn. Expanded shale concrete was used for floor slabs and structural members of the building. Architects: Hart & McBryde. Construction by Foster & Creighton Company and McDonald Construction Company, operated jointly as Creighton-McDonald Contractors. Ready mixed concrete by T. L. Herbert & Sons, Nashville.

masonry units

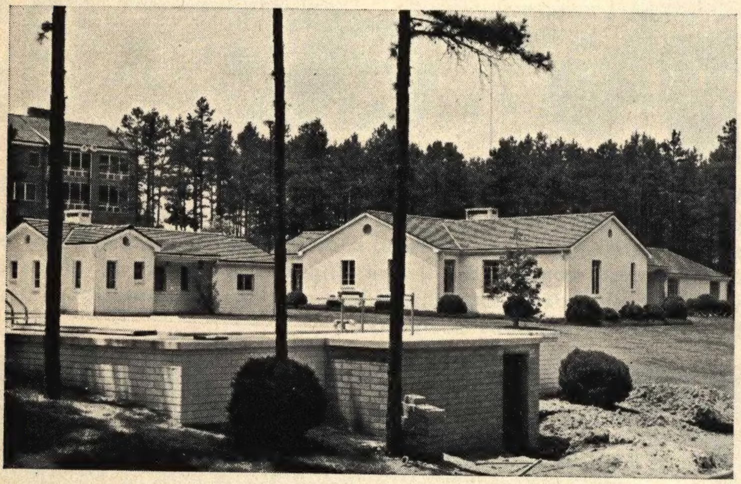
Masonry units made of expanded clay and shale aggregate are more and more in demand because they exceed the requirements of building codes while offering the advantages of lightness of weight without loss of strength. Blocks made from this product meet ASTM Spec. for absorption property. Concrete masonry units made from cement and any aggregate will exhibit expansion and shrinkage due to wetting and drying, as is commonly known. Lightweight concrete units have a low shrinkage factor—the maximum movement for expanded clays and shales is 0.007 inches per foot of length from an oven dry to saturated condition.

For attractive-appearing texture, for a great variety of decorative effects (the lightweight block can easily be formed and cut), for plastering direct without costly furring or lathing, masonry units of expanded clay and shale lightweight aggregate are recommended.

The increasing popularity of masonry units could be cited in every section of the country by specific example, but space does not permit. The ever-growing trend to lightweight blocks is illustrated by the fact that in Connecticut, Yale University Physics Research building, a $7-million job, used blocks for practically all the exposed exterior. In the $8½-million Southern New England Telephone building in New Haven, lightweight block was used throughout the entire interior. Twelve schools, shopping centers, three churches and other construction projects point up the great interest and confidence in the product on the part of architects, contractors, engineers and owners in this representative area.



WHAT'S COOKING?—These expanded shale lightweight blocks nestle neatly against a built-in oven in the modernly designed kitchen of this home, while on the other side they form a wall for a built-in broiler unit.



OUTDOOR LIVING AREA—Lightweight blocks were used for a 10-room home built of 4" high units. The playhouse is built on a ¼" scale of standard concrete brick. This is the home of Mr. and Mrs. Allen Johnson Jr., Salisbury, North Carolina. Architect: John R. Hartlege.

NIGHT SCENE—Bright-colored interior walls of lightweight expanded clay block, highly visible in this night scene, contribute not only to the decor but to the good acoustics of the new Henry Chaney Branch Library, Detroit, Mich. The 4" high sound-absorbent block are laid with vertical joints flush and horizontal joints raked. Architects: Louis F. Redstone, and his associate, Allan G. Agree. General Contractor: McKinstrie Construction Company.

facts about lightweight aggregate

Chemical Analysis: Typical analyses of expanded clays and shales are given below:

Silica (SiO_2)	**64.32%**
Aluminum Oxide (Al_2O_3)	**26.11**
Iron Oxide (Fe_2O_3)	**4.32**
Titanium Oxide (TiO_2)	**1.88**
Calcium Oxide (CaO)	**0.66**
Magnesium Oxide (MgO)	**0.17**
Sulphur Trioxide (SO_3)	**0.21**
Phosphorus Pentoxide (P_2O_5)	**0.08**
Alkalies (Na_2O and K_2O)	**1.80**

gradation:

All commercial gradations meet ASTM Spec. C130-42 and later tentative specs for lightweight aggregates.

unit weights:

The aggregates meet ASTM Spec. C130-42 and later tentative revisions for unit weight requirements.

soundness:

Expanded clays or shales pass ASTM Spec. C130-42 for soundness of aggregates by the use of sodium sulfate or magnesium sulfate.

structural properties:

The aggregates are available in recommended mixes using various sizes. Data can be obtained from the individual producers showing materials required for standard quantities of concrete.

Of growing importance to architects and builders is the requirement that material must have such properties as:

1. Light Weight. A typical block made with expanded clay or shale aggregate is 10 to 12 pounds lighter than the old type masonry units. The average weight of a standard 8 x 8 x 16″ block with 1¼″ face shell is approximately 27 pounds. Structural concrete made with lightweight aggregate weighs approximately 98 pounds per cubic foot. This speeds up laying, saves labor and reduces dead weight. In multi-story buildings, it is an ideal material.

2. Strength. Though it weighs one-third less, expanded clay and shale has in general the same compressive strength as comparable mixes of sand-and-gravel concrete.

3. Durability. Laboratory tests and actual-on-the-job experience show extreme resistance to freezing and thawing. There is minimum expansion and contraction.

The cellular nature of the product gives it a very high degree of heat and sound insulating properties. It is fireproof. Because it is chemically inert, there is no worry about corrosion, stain or discoloration.

A "Coefficient of Heat Transfer (U)" report conducted by a testing laboratory for expanded clay roof slabs noted that:

The overall coefficient of heat transfer (U) or heat transferred per unit time, per unit area, per degree overall for a roof consisting of lightweight aggregate roof slabs and a built up roof of bitumen and felt gravel or slag surfaced is as follows:

Mix No. 1

1-10

$$U = \frac{1}{\frac{1}{1.21} + \frac{1}{1.666} + \frac{1}{1.33} + \frac{1}{6.00}} = .427$$

Mix No. 2

1-12

$$U = \frac{1}{\frac{1}{1.21} + \frac{1}{1.630} + \frac{1}{1.33} + \frac{1}{6.00}} = .424$$

Where Conductances (Ca) are:

§ 1.21 Surface Coefficient for Still Air
§ 6.00 Surface Coefficient at 15 miles per hour
† 1.33 Built up roof, Bitumen and Felt, Gravel or Slag Surfaced
* 1.666 Thermal Conductance of Slab No. 1
* 1.630 Thermal Conductance of Slab No. 2

authority:

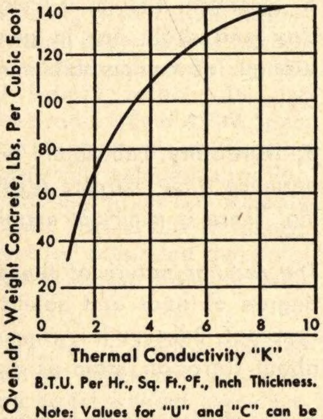
§ A.S.H.V.E. Handbook
† Handbook of Engineering—Eshbach
* Pittsburgh Testing Laboratory Report August 30, 1954 Laboratory number 458883

typical test data

It should be emphasized that expanded clays and shales are ideal for and can be economically used to produce concrete masonry units to meet ASTM Spec. Designation C90-44.

Note:

Values for "U" and "C" can be calculated with these data by methods set out in the guide book of The American Society of Heating and Ventilating Engineers.



Note: Values for "U" and "C" can be calculated with these data by methods set out in the guide book of The American Society of Heating & Ventilating Eng.

Thermal "U" factor:

Representative heat conductance (C) and overall thermal conductivity (U) of typical masonry wall construction is given in the following chart. Data are from actual tests on standard 3-cell 8″ by 16″ units weighing 28-29 pounds each with compression resistance of 1100-1200 PSI gross area basis.

Type of wall section
(1) Plain wall, no surface finish
(2) ½ inch plaster directly on inner surface of wall
(3) Plain wall, no surface finish, loose aggregate fill in core spaces
(4) 4″ by 8″ by 16″ blocks, cavity wall, 2″ space between walls, no exterior finish

Wall No.	1	2	3	4
Temperature air				
Warm side °F	80	80	80	80
Cold side °F	—.15	0	—.2	0
Mean temperature °F	39.0	40.0	39.9	40.0
Conductance (C)	.610	.559	.389	.360
"U" at 15 mile wind	.408	.385	.296	.278

acoustical properties:

The textural qualities of concrete masonry units give them sound control properties as is summarized in the following table. The units employed in this series of tests were a medium textured Grade A block.

(1) Sound absorption
- (a) Plain wall, no surface finish
- (b) Plain wall, painted one side with casein type paint

(2) Sound transmission
- (a) Plain wall, no surface finish
- (b) Plastered ½ inch, both sides
- (c) Plain walls, painted both sides with casein type paint
- (d) 4″ by 8″ by 16″ plastered ½ inch both sides
- (e) 4″ by 8″ by 16″ cavity wall, no finish, 2 inch space, plastered ½ inch on one inner surface

Wall No.	Frequency CPS	Coefficient of absorption						
		125	250	500	1000	2000	4000	Noise
1a		.71	.58	.31	.22	.58	.30	.45
1b		.85	.55	.27	.23	.46	.19	.40
		Transmission loss in decibels						
2a		10	18	30	31.5	32.5	47.5	25
2b		39.5	52	53.5	58.5	63.5	65	54
2c		14.5	23.5	35.5	37.5	40.5	42.5	31
2d		40	51	51	58.5	63	59.5	53
2e		41.5	52	54	60	64	62.5	54

block expansion from oven dry to saturated condition:

Type of aggregate	Block age at test	Expansion inches per foot
Sintered clay, shale	28	.00672
Rotary kiln shale	28	.00684
Cinder (bituminous)	90	.00744
Pumice	60	.01056

the association and its services

The Expanded Clay and Shale Association is made up of leading producers in a wide geographical area of the United States. It was formed to foster tests and research on a cooperative basis in order to seek out the finest aggregates and better construction methods. As improvements are determined, the association makes the data available immediately to architects, engineers, contractors and all others who are interested. Technical assistance and service is available through the association and its producer-members. It also serves as a clearinghouse for approved and reliable information on clay and shale aggregates, and the ways to make highest quality, lowest costing use of these aggregates.

For information, get in touch with the association headquarters (see address below) or the individual producer in your area whose name and location is listed below.

EXPANDED CLAY and SHALE ASSOCIATION
522 Hamilton Street, Allentown, Penna. telephone: HEmlock 3-6018

members:

Carolina Tuff-Lite Corp. ("TUFF-LITE")
Salisbury, North Carolina

Cinder Concrete Products, Inc. ("CLALITE")
1155 West 5th Avenue
Denver 4, Colorado

Lehigh Materials Company ("LELITE")
P.O. Box 274
Tamaqua, Pennsylvania

Light Weight Aggregate Corp. ("BESLITE")
12720 Farmington Road
Livonia, Michigan

Moss Light Weight Aggr. Co. ("DENILITE")
373 Adams Street
Memphis, Tennessee

Onondaga Brick Corp. ("HAYDITE")
Warners, New York

Shalite Corp. ("SHALITE")
P. O. Box 441
Knoxville, Tennessee

I. L. Stiles & Son Brick Co. ("STILITE")
North Haven, Connecticut

Virginia Light Weight Aggr. Corp. ("WEBLITE")
P. O. Box 319
Charlottesville, Virginia

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